The difficulty of two elements having an identical spectrum is considerable; it is suggested that inasmuch as the spectra are characteristic of the movement of the electrons in an element, rather than of its mass, two elements in which the electrons will have identical motions must have the same spectrum. Mr. Aston's researches on two "neons," which can be separated from each other by diffusion, but which show no difference in spectrum, are adduced as proof of this point of view. It will be remembered that it was owing to Sir J. J. Thomson's finding that ordinary neon contains a small proportion of an element of atomic weight 22, which led to Mr. Aston's research. Here, again, one can only wonder that two elements, neon I. and neon II., of different atomic weights, 20 and 22, which can be separated by diffusion, according to Mr. Aston, have identical vapour-pressures, for they cannot be separated by fractional distillation.

Mr. Soddy has invented a modification of the periodic table which represents his new arrangements; it is three-dimensional.

Much of the book under review is taken up with detailed discussion of the generalisation of which a brief account has been given. The concluding section on the "Nature of the Argon Gases," puts forward the view that these elements are inactive owing to their great affinity for their valency electrons. Whereas an atom of sodium, in combining with an atom of chlorine, loses an electron to the chlorine, itself becoming an ion, an atom of argon has no such tendency, being very firmly bound to its electron.

This work of Mr. Soddy's must be termed "provisional"; it brings before the reader the state of knowledge regarding the sequence of radio-active elements, but it does more; it elaborates a hypothesis capable of correlating these facts; a very ingenious theory which, however, its author would be the first to acknowledge is still in need of support.

W. R.

TECHNICAL MYCOLOGY.

(1) *Einführung in die Mykologie der Gebrauchs- und Abwässer.* By Dr. A. Kossowicz. Pp. vii + 222. (Berlin: Gebrüder Borntraeger, 1913.) Price 6.60 marks.

(2) *Die Gärungsgewerbe und ihre naturwissenschaftlichen Grundlagen.* By Prof. W. Henneberg and Dr. G. Bode. Pp. v + 128. (Leipzig: Quelle und Meyer, 1913.) Price 1.25 marks.

(1) DR. KOSSOWICZ surveys the subjects of water and sewage purification from the bacteriological point of view. To a large extent the book summarises researches that have been carried out on these subjects, though, on account of their number, the summary of each research is necessarily very brief. Its chief value consists in the contained bibliography—every page teeming with references to the literature—and the student, engineer, or hygienist desiring a guide for his practice will be bewildered by the mass of detail. Diagrams and figures of filters and filter-beds, sterilising apparatus, sedimentation tanks and plant for the biological treatment of sewage have been freely introduced, and form a useful feature.

The earlier chapters deal with the bacterial content of waters and the factors which modify it, the occurrence of pathogenic microbes in water, and the self-purification of water, and in subsequent chapters the subjects of sand-filters, chemical and other methods for the purification and sterilisation of water, sewage farms, the biological treatment of sewage, and the purification of trade effluents are considered.

(2) This little book gives a brief and simple, though at the same time excellent, survey of fermentations and the fermentation industries. The yeasts, bacteria, and moulds concerned in fermentations—alcoholic, souring of milk, acetic and butyric acids, etc.—are first described, with an account of their structure, development, and occurrence. The chemical composition of the substances fermented, the nature of the chemical changes involved, enzymes and enzyme action are next considered, and finally a description is given of the industrial processes involved in the production of beer, wine, and spirits, pressed (German) yeast, bread and vinegar, soured milk and "sauerkraut," cocoa and coffee. The text is illustrated with a number of figures of the micro-organisms involved and of the industrial plants employed in the fermentation industries.

R. T. Hewlett.

HUMAN MATHEMATICS.

(1) *A First Book of Practical Mathematics.* By T. S. Usherwood and C. J. A. Trimble. Pp. iv + 182. (London: Macmillan and Co., Ltd., 1913.) Price 1*s.* 6*d.*

(2) *Practical Geometry and Graphics for Advanced Students.* By Prof. Joseph Harrison and G. A. Baxandall. Enlarged Edition. Pp. xiv + 677. (London: Macmillan and Co., Ltd., 1913.) Price 6*s.*

(3) *Practical Mathematics.* By Norman W. M'Lachlan. Pp. viii + 184. (London: Longmans, Green and Co., 1913.) Price 2*s.* 6*d.* net.

(4) *Exercices d'Arithmétique.* Enonces et Solutions. By J. Fitz-Patrick. Avec une Preface

de J. Tannery. Troisieme Edition. Pp. vi + 707. (Paris: A. Hermann et Fils, 1914.) Price 12 frs.

(1) IN the old days a boy had to reason in geometry "acording to the rules of the game." Many a boy felt that he must put aside common sense for fear that it might contradict the "rules," and that he must "play the game according to the rules." Hence came grotesque howlers, and the boy felt it unreasonable that grotesque results should be ridiculed, for they arose from strict adherence to rules. While in the present happy days we have altered that as regards geometry, the old method persists in algebra; the subject is treated in a purely abstract manner, it has no relation to anything in everyday life; the student can only commit to memory the rules of the game, and do his best to play the game. In this case the results also are generally abstract, so that appeal to common-sense would be impossible even if the boy allowed the validity of the appeal.

Now, however, a brighter dawn is breaking for the ill-treated boy. Usherwood and Trimble connect the algebraic work with the concrete throughout. The boy no longer has to play a game with rules he does not understand. Each algebraic process arises out of concrete instances, which are themselves easy of comprehension, and give a common-sense meaning to the process. The book is thus in the van of the movement to humanise algebra as geometry has been humanised, and in another generation no headmaster will mourn the blighting influence which $x+y$ had upon him.

The authors approve of the use of contracted methods, as do most of the best teachers at the present moment. We venture, however, to question whether these authors and teachers do well in this matter. It is customary to work to a significant figure more than will be required in the result; this generally gives the result to the required approximation, but not always. Are we to chance the accuracy, or are we to complicate the process further by an estimate of the trustworthiness of the result? Moreover, the estimation of the number of figures to be retained, even in the normal case, is a matter of no little skill; we have frequently known professors and schoolmasters of good standing to be at fault.

There appears to be no educational principle at stake, and the question is simply whether contracted methods conduce to speed and accuracy or not. Does the shortness of the contracted calculation compensate for the time spent in deciding how far to contract, and for the chance of error by excessive contraction? For the expert calculator, like the teacher of arithmetic or the observatory computer, it compensates without doubt. For ourselves, and we imagine for most people (adults and children), contracted methods in their strict form do not compensate. For us the best way is to calculate stolidly through, and at the end throw away the unnecessary figures, or if the numbers get very heavy, to contract to a modified extent, keeping, perhaps, two or three more figures than a strict contractionist would allow.

(2) Why do the universities so carefully exclude Mongian geometry from their "pure" mathematical courses? To many a pure mathematician the happening upon such a book as Harrison and Baxandall's is like the acquisition of a new sense. His ideas of solid geometry are those of Euclid's Eleventh Book, in which he is instructed to "draw a plane through three given points," or to carry out in three dimensions some construction that has been discussed in the plane, and which he had imagined was meant to be carried out on a sheet of paper with ruler and compasses. On arriving at the Eleventh Book he discovers that when Euclid says "draw a plane through three given points," he only means that three points determine a plane; on the Book I. construction carried out in three dimensions he has to put such interpretation as he can.

In course of time he happens upon a book on Practical Solid Geometry and regions unknown to Euclid and the universities. With what joy he finds that it is possible to represent points in space upon a sheet of paper, and actually possible to draw a plane through them. He wishes he was young again so that he might follow up all the wonderful consequences, actually carrying out all the constructions and not merely talking about "how it is done," as was his custom at the university. And Harrison and Baxandall would be a first-rate book to use if he could be young again. It contains the most alluring problems, wonderful in variety. There are no watertight compartments, but every branch of mathematics that can help is allowed to do so. The language, moreover, is excellent, a statement that cannot always be made of English mathematical writing.

Part III. of Messrs. Harrison and Baxandall's book is Graphics, an admirable subject, neglected in pure mathematics in the same unaccountable way as Mongian geometry. The story runs that Prof. P. G. Tait held that the analytical method was always superior to the graphical, and applied it to ascertain the stresses in the Forth Bridge. Although a man of unrivalled intellectual power he failed that time. Those days are gone, the schools are learning the value of Graphic Statics, and perhaps in time the universities may follow.

(3) Mr. M'Lachlan's book is mainly a collection of exercises in geometry, arithmetic, algebra, and trigonometry. They are all good, natural questions, straight from the workshop and other human sources. For the engineering student (for whom they are designed) they are ideal, while other students also will find much of value. The text is inferior in value, as if the writing of it had been a perfunctory task; but there is not much text, and the exercises alone are well worth the half-crown at which the price is fixed.

(4) M. Fitzpatrick's book of exercises in algebra might have been written for the express purpose of enabling English mathematicians to thank God that they are not as other men. There are 1300 questions, drawn mainly from French examination papers. The book contains all the old artificial questions which England is in process of discarding, and among the whole thirteen hundred we have been unable to find one natural problem taken straight from human life. In one particular, however, it is for the English mathematician to drop the *rôle* of Pharisee and take up that of Publican. We have nothing but praise for the clearness and exactness of the language of M. Fitz-Patrick's book, while in the first and third of the English books now under review we find carelessness of language that often produces ambiguities, and sometimes amounts to misstatement. In language we have much to learn from France. D. B. M.

OUR BOOKSHELF.

The Child: Its Care, Diet, and Common Ills. By Dr. E. Mather Sill. Pp. viii+207. (New York: Henry Holt and Co.) Price 1 dollar net.

In the modern nursery the mother requires information on many questions which used to be disregarded or left entirely to the discretion of the doctor. She now realises that in her kingdom of the nursery, preventive medicine depends to a large extent upon her care and foresight. If she provides her children with the conditions they require for healthy development, they tend to remain well and happy, and the services of the physician will be required seldom.

Dr. Sill has had a large experience of children's medicine, and, in this small volume, he has contrived to present, in simple language, much valuable information on the clothing, feeding, general hygiene, and minor ailments of children. It is an unpretentious book, admirably adapted to its purpose as a handbook for young mothers. It is well printed, and is supplied with attractive illustrations and an index.

Some useful tables are included, and a few recipes for invalid dishes, together with clear directions for the preparation of simple domestic remedies, such as the various kinds of medicated baths. The common slight ailments of childhood are described, and a list is given of the poisons most liable to invade the nursery, together with their domestic remedies.

In every treatise on infant care, the instructions for the modification of cow's milk for bottle-fed babies are apt to be involved and lengthy, and perhaps in the little volume under review the author has not been entirely successful in avoiding this fault.

The book closes with advice to parents to tell their children some elementary physiological facts about the phenomenon of reproduction and the care that they should take of their bodies. This wise advice is strengthened by suggestions as to the best way of explaining these matters to children.

Dr. Sill's book is one to recommend cordially, as it is certain to be appreciated by those for whom it is intended.

An Account of the Morisonian Herbarium in the possession of the University of Oxford. By Prof. S. H. Vines, F.R.S., and G. Claridge Druce. Pp. lxviii+350+plates. (Oxford: Clarendon Press, 1914.) Price 15*s*. net.

All who take an interest in the history of botany, and especially the history of botany in Britain, will be glad to see the second work on the Oxford Collections, which has just been issued under the joint authorship of Prof. Vines and Mr. Druce. These names are a guarantee both of accuracy and of erudition, nor will the reader fail to discover on every page of the interesting and valuable introduction a breadth of acquaintance with the old literature, as well as with sources of information by no means readily accessible. The position of the Bobarts, father and son, in relation to the carrying out of Morison's great work, is made very clear, and, incidentally, the earlier history of the Oxford Botanic Garden is well told in the letters and remarks of those who were interested in its inception and early progress.

The bulk of the work is occupied by the "Plantarum Historiæ universalis Oxoniensis, pars secunda et pars tertia." The second part of the "Historia" was issued by Morison, while the younger Bobart was entrusted with the completion of the third part. In the present work, in which the plants are enumerated, the modern reader will find the critical notes incorporated by the authors of great service in identifying the older names and descriptions. The book is a scholarly one, and well worthy of the reputation of its authors.

A Gypsy Bibliography. By Dr. G. F. Black. Pp vii+226. (London: Bernard Quaritch, 1914.) Price 15*s*. (Gypsy Lore Society, Monograph No. 1.)

For the first time, Dr. G. F. Black, of the New York Public Library, has undertaken the difficult task of compiling a comprehensive bibliography